U. S. DEPARTMENT OF AGRICULTURE
FARMERS' BULLETIN No. 1420

HANDLING ROUGH RICE TO PRODUCE HIGH GRADES

THE ENTIRE RICE INDUSTRY will profit by the production and marketing of better rough rice. A crop which is of uniformly high quality will result in greater returns to the producers, will facilitate domestic distribution and foreign exportation, and will create a stronger demand for American rice, all of which conditions will cause a firmer and steadier market.

High-quality milled rice can not be produced from low-quality rough rice. Rough rice will not command high prices unless milled rice of high value can be produced from it.

Many of the factors which cause rough rice to bring a low price on the market can be reduced or eliminated. This can be accomplished by the use of better seed, by better cultural methods, by harvesting the crop when it is in the proper stage of maturity, by improved methods of shocking and threshing, by cleaning the threshed rice, and by providing suitable storage facilities for the threshed grain.

Weeds and red rice cause a reduction in yield and lower the value of the threshed rice. The elimination of weed seeds and red rice from seed rice and the eradication of weeds and red rice in the fields will result in a higher monetary return to the producer.

Other grains should not be mixed with rough rice. Such mixtures are a troublesome factor in milling and result in reduced values.

Washington, D. C. Issued June, 1924

HANDLING ROUGH RICE TO PRODUCE HIGH GRADES.

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THE MARKET PROBLEM.

RICE IS USED almost exclusively for human consumption, and it goes to consumers largely in a form which makes it peculiarly sensitive to defects of quality, even such as affect merely its general appearance. In the process of milling all defects must be removed if the highest competitive price is to be secured. High-grade milled rice can not be efficiently produced from low-grade rough rice.

The United States rice crop of 1923 amounted to 33,256,000 bushels of rough rice, produced chiefly in Louisiana, Texas, Arkansas, and California, though some rice is also produced in South Carolina, Georgia, Florida, and Mississippi. The crop of 1922 was the third largest crop made since 1904, the first year statistics were available, while the 1923 crop was the smallest crop since 1915. About half of the crops of 1919–1921 were exported, and while there have been some imports of rice, these have been increasingly smaller since 1917, when there was a short crop and heavy consumption.

The annual per capita consumption of rice in the United States is about 6.8 pounds, which is materially less than that of any of the other cereal grains produced here. The secondary position of rice in the diet of the people of this country, together with the large surplus for export, tends to create a market condition in which the prices to producers are rather definitely dependent on what can be obtained for the finished product, the demand for which is limited by custom rather than by comparative food value. The price for rough rice also varies with the cost of milling, which is intimately associated with the grades of rough rice. Rough rice can not command a high price unless a high percentage of milled rice of high value can be produced from it.

The effective demand for whole-grain rice has much to do with the prices paid for rough rice. The grower must produce rough rice which will yield a high proportion of sound head milled rice if he is to obtain the best possible price afforded by the market, for the quality and condition of rough rice governs to a marked degree the

quality of the milled rice and also the cost of milling through mill yields. The various factors that reduce the value of rough rice for milling purposes are largely within the control of growers.

CLASSES OF ROUGH RICE.

Rough rice is classed according to size and shape of kernels[1] as Long, Short, Round, and Mixed Rough Rice. Each of these classes requires separate treatment in the milling process, as milling efficiency is affected by a mixture of classes of rough rice. In the beginning of the milling process the hulling stones are usually set to take the hulls off the longest kernels first; the shorter and smaller kernels escape being hulled at this time. The shorter kernels are then put through "return stones," which are set closer, so that the hulls of these kernels may be loosened, too. In case there is only a

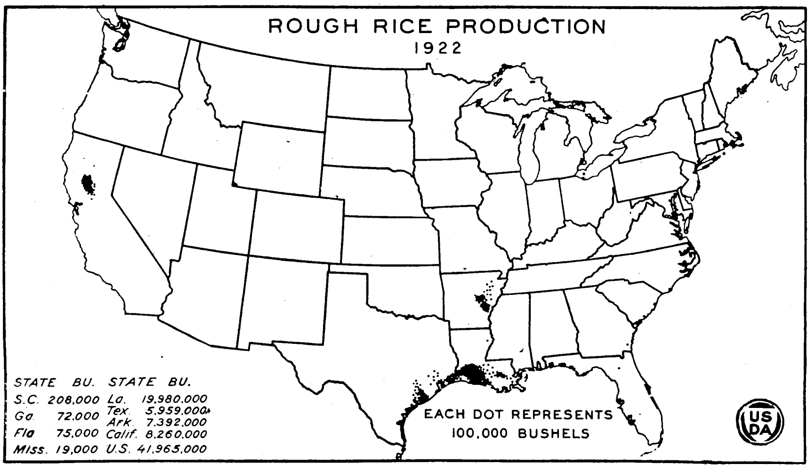

FIG. 1.—Areas of heaviest production of rice in the United States.

small percentage of long-grain rough rice in a lot of short-grain rice, it is not practicable to set the first stones to take care of the few kernels of long-grain rice in the mixture only, as that would seriously delay the process of milling. In such a case the stones must be set to loosen the hulls on the longest kernels of the short-grain rice, and when this is done most of the long-grain rice is broken in the stones and the percentage of whole-grain rice that can be made from the lot is reduced.

Difficulties caused by mixture of classes may be overcome by growing one class only or by keeping the classes separate on the farm.

GRADES FOR ROUGH RICE.

The United States standards divide each class of rough rice into seven grades. The first six grades are numbered and the last is designated as Sample Grade.

[1] See Department Circular No. 290, United States Grades for Rough Rice, effective August 1, 1923, recommended by the United States Department of Agriculture for the grading and marketing of rough rice.

Rough rice, to meet the highest grade, must contain a large percentage of sound vitreous kernels, must have a low moisture content, and must be practically free from foreign seeds, other grains, red rice, and damaged kernels. Such rice will produce a high milling yield of whole kernels (head rice) of good quality and will therefore bring a high price on the market.

Grade No. 1 for the class of rough rice which includes the short-grain rices, such as those known commercially as Blue Rose, Louisiana Pearl, and Early Prolific, requires that the rice to meet this grade—

(*a*) shall be cool and sweet, and of good color,
(*b*) shall have a test weight per bushel of at least 45 pounds,
(*c*) may contain not more than 14.5 per cent of moisture,
(*d*) may contain a total of not more than 1.5 per cent of damaged kernels, red rice, and foreign material, which total of 1.5 per cent may include no heat-damaged kernels, not more than 1 per cent of kernels damaged other than by heat, not more than 0.5 per cent of red rice, not more than 0.1 per cent of cereal grains, not more than 0.1 per cent of seeds, and not more than 0.2 per cent of foreign material other than cereal grains and seeds,
(*e*) may contain not more than 2 per cent of broken hulled kernels, and
(*f*) may contain not more than 1 per cent of whole kernels of rice of other classes.

The same requirements are specified for grade No. 1 for the class which includes all long-grain rough rices, such as those known commercially as Honduras, Carolina Gold, Carolina White, Fortuna, and Edith, and the class which includes all round-grain rices, such as those known commercially as Japan or Japanese, including Wataribune, Shinriki, Butte, Acadia, Colusa, Ousen, and Calora, except that the test weight per bushel required for No. 1 Long rice is specified as 43 pounds and for No. 1 Round rice the minimum test weight is 46 pounds.

COMMON DEFECTS OF ROUGH RICE.

The common defects appearing in rough rice are: Red rice, weed seeds, other grains, small mud lumps, gravel, stones, other foreign material, thresher-broken kernels, damaged kernels, heat-damaged grains, a high moisture content, and a low test weight per bushel. All these reduce the value of rice containing them, principally because the quality and condition of the rough rice governs to a very large extent the cost of milling the rice, the milling yields, and the quality and condition of the milled rice that can be made from the rough rice.

It is possible to remove some of these defects from rice in milling, but when any one of them is present to a high degree in the rough rice it is very difficult and often impossible to prevent its appearance in the milled rice. The commercial value of milled rice is based largely upon its general appearance. Every reasonable precaution should therefore be taken by the grower to prevent the appearance of defects in the rough rice before it goes to the mill in order to make it possible for the miller to produce high-grade milled rice.

MILLING DIFFICULTIES CAUSED BY DEFECTS.

The daily output of the mill is often greatly retarded because of the common defects in rice. Moreover, most of the foreign material

removed from rough rice during its preparation for milling is worthless to the miller and it costs money to remove it. Foreign material, consisting of pieces of straw, sticks, large mud lumps, and the very large and very small weed seeds, can be removed comparatively easily from rough rice during the preparation of the rice for milling, but such defects that are of approximately the same size and shape as the rice kernels are very difficult to separate from the milled rice. Some of the weed seeds have other characteristics that make them particularly difficult to eliminate.

Damaged kernels usually break more easily than sound kernels and a milling loss is caused because of a decrease in the yield of whole kernels and an increase in the yield of broken particles and byproducts. In milled rice the various classes of broken rices generally sell for from 1 to 4 cents a pound less than the whole-grain rices. Damaged kernels in the rough rice usually show in milled rice even when they do not break up in milling.

False kernels, or kernels of rough rice which have little or no substance in the hulls, and very small immature kernels are cleaned out of rough rice at the mill with the foreign material and represent the same kind of loss to the miller as foreign material. Immature kernels which are large enough to stay in the rice during milling are often chalky in texture and are generally broken in the milling operation. In addition, admixtures of immature and false kernels reduce the weight per bushel or "cup weight" of rough rice somewhat, and consequently tend to lower the grade.

Thresher-broken kernels, or broken-hulled kernels, reduce the milling value of rice for the obvious reason that as the percentage of broken kernels in rough rice is increased the milling yield of whole-grain rice is decreased.

Excessive moisture in rough rice causes the kernels to be softer and more susceptible to breakage in milling. Damp rough rice often causes some of the milling machinery to clog with damp bran or polish. A high moisture content in rough rice results in damp milled rice and there is danger of spoiling in storage.

Red rice is a very troublesome factor in milling and causes a large financial loss to the rice industry yearly. The red rice paddy kernel is usually smaller in size than the average paddy kernel of the white rices grown in the United States, which makes it difficult to remove the hulls from the red rice in milling, and makes it practically impossible to scour off all of the red bran from the red rice kernels in the mixture. Consequently, a large percentage of the paddy kernels (unhulled kernels) found in milled rice consists of kernels of red rice, and in practically all rice milled from lots which contain red rice there are kernels of red rice on which there are still some streaks of red bran. These red streaks detract from the appearance of the lot as a whole, and as a result reduce the market value of the rice.

When there is a large percentage of red rice in a milling lot the finished rice usually contains not only a large number of red-streaked kernels, but often the color of the finished lot as a whole is affected, because the red bran, coming in contact with the kernels of white rice during the milling operation, imparts to them a rosy or red appearance. As a rule, the kernels of red rice break more easily in milling than those of white rice. For this reason, rough

rice that contains red rice is usually milled close, in an effort to remove as much of the red bran as possible from the red rice kernels. The milling yield of whole-grain rice is generally reduced and this reduction is in proportion to the red rice contained in the lot.

HANDLING TO AVOID COMMON DEFECTS.

It is poor economy to spend time and money in producing a crop of rice and then lose part of the quality and profit through poor handling. Defects in rough rice can be reduced considerably or eliminated entirely by careful attention to details throughout the process of production—by the use of better seed, by better cultural methods, by harvesting the crop at the proper stage of maturity, by improved methods of shocking and threshing, by cleaning the threshed rice, and by providing suitable storage facilities for the threshed grain.

GETTING RID OF WEED SEEDS, RED RICE, AND OTHER CEREAL SEEDS.

Presence of red rice and weed seeds in threshed lots is often the direct result of planting such seeds with the seed rice. Many kinds of weed seeds are found in rough rice, but less than 25 occur commonly. The principal one is barnyard grass, which is prevalent in California. The light weight of this seed and its appendage or "tail" cause the difficulty in separating it from the rice. Representative kernels of 24 kinds of foreign seeds commonly found in rough rice are illustrated in Figure 2. The 20 kinds of foreign seeds and grains most commonly found in rough rice, named in the order of their frequency, are: Barnyard grass, tall indigo, curly indigo, alligator head, plantain, oil seed, turtle back, low senna, Mexican weed, king-head, spearhead, buck chess, large button weed, goat's beard, sensitive pea, morning glory, coffee weed, green foxtail, wheat, and barley. As the common names for these weeds vary in different localities, their botanical names are given in Table 1.

TABLE 1.—*Common and botanical name of weed seeds found in rough rice.*

Common name.	Botanical name.	Common name.	Botanical name.
Barnyard grass	Echinochloa crus-galli.	Spearhead	Rynchospora corniculata.
Tall indigo	Sesbania macrocarpa.	Buck chess	Lolium temulentum.
Curly indigo	Aeschynomene virginica	Large button weed	Diodia virginiana.
Alligator head	Diodia teres.	Goat's beard	Molochia corchorifolia.
Plantain	Commelina sp.	Sensitive pea	Cassia nictitans.
Oil seed	Caperonia palustris.	Morning glory	Convolvulaceae.
Turtle back	Croton sp.	Coffee weed	Daubentonia longifolia.
Low senna	Cassia tora.	Green foxtail	Chaetochloa viridis.
Mexican weed	Scleria reticularis.	Wheat	Triticum aestivam.
King-head	Ambrosia bidentata.	Barley	Hordeum vulgare.

BETTER SEED RICE NEEDED.

It is of primary importance that the rice used for seed be free of foreign seeds and red rice and that it show good germinating power. Yet, only 4 lots of the seed rice being planted on 29 farms examined by investigators contained neither weed seeds nor red rice, while all the others showed the presence of either one or both kinds of seed. Too often it is thought that a few kernels of red rice or a few weed seeds in a small lot of seed rice is not particularly harmful, but

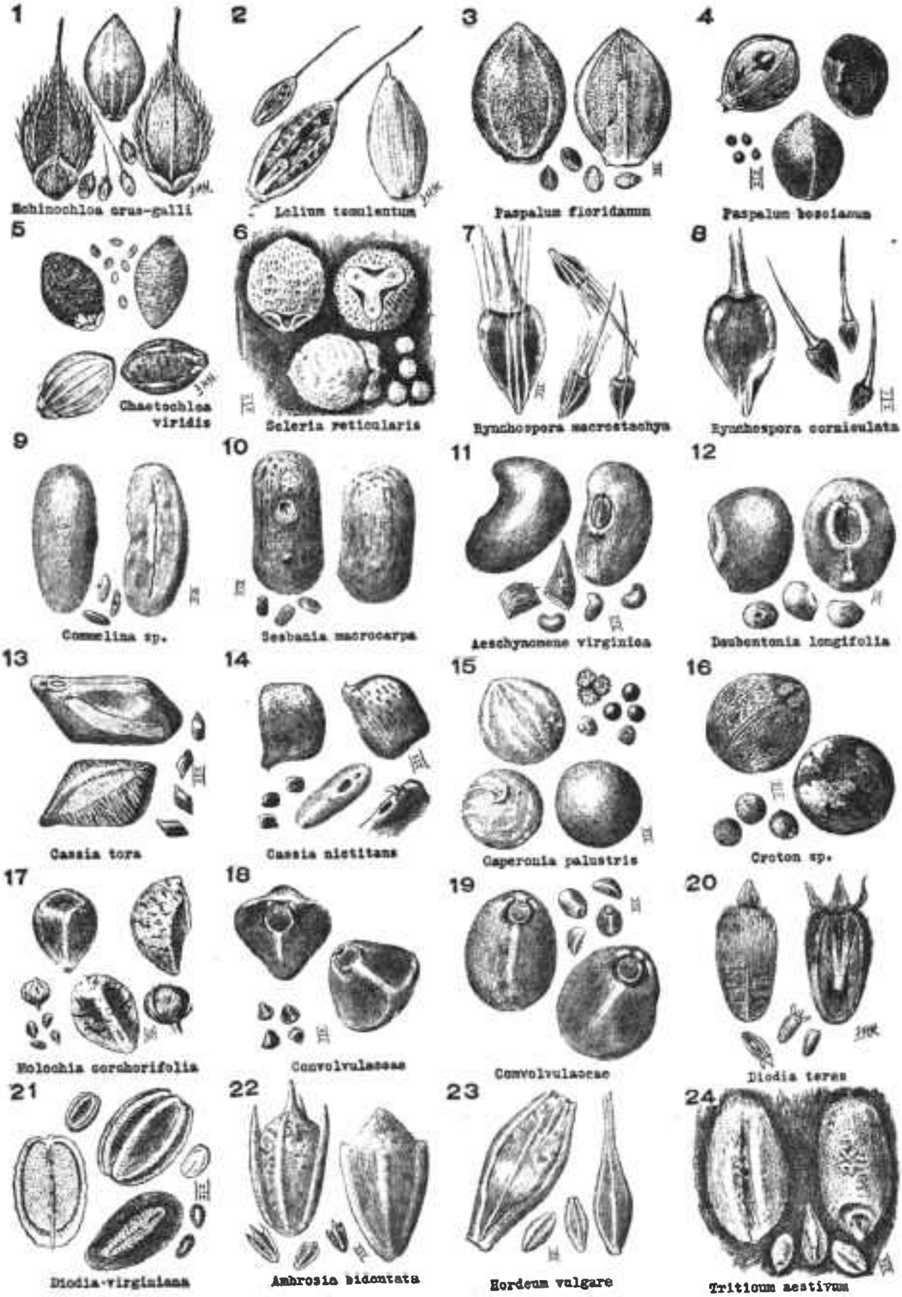

FIG. 2.—Foreign seeds found in rice.

although the amount of these noxious weeds may be seemingly small the number of them planted on an acre is alarmingly large. The combined number of weed seeds and red rice being planted per acre on one farm totaled over 16,000.

During recent planting seasons samples of seed rice were obtained from different localities throughout the rice-producing areas of the South, and were examined for red rice and weed seeds. The results are shown in Table 2. Only about one-fourth of the samples obtained were free of red rice. An average of 32 grains of red rice per pound was found in these samples. On the basis of sowing 80 pounds of seed rice per acre, this would mean that an average of 2,560 seeds of red rice were planted on each acre of ground along with the white rice. The seed rice being planted on 2 of the farms showed that approximately 11,000 seeds of red rice were being planted per acre; on 3 farms, between 5,000 and 10,000 red rice seeds; on 4 farms, between 2,000 and 5,000 seeds of red rice; and on the remainder of the farms the samples indicated that red rice seeds varying in number from 0 to 2,000 were being planted per acre.

Of the samples obtained, approximately 45 per cent contained no weed seeds. The average number of weed seeds per pound for all the samples was 34, or 2,720 planted per acre. The weed seeds commonly known as tall indigo, curly indigo, plantain, yellow foxtail, and king head predominated in these samples.

Considering both red rice and weed seeds as foreign seeds, one sample showed that 16,880 foreign seeds were planted per acre; 3 samples indicated that from 10,000 and 15,000 foreign seeds were being sown; 4 samples indicated that between 5,000 and 10,000 foreign seeds were being planted; 8 of them indicated the planting of between 2,000 and 5,000 foreign seeds; and the remainder of the samples indicated that foreign seeds varying in number from 1 to 2,000 were being planted per acre.

TABLE 2.—*Weeds and red rice planted per acre with seed rice, based on 80 pounds of seed rice per acre.*

Seed sample number.	Weed seeds.	Red rice seeds.	Total weed and red rice seeds.	Seed sample number.	Weed seeds.	Red rice seeds.	Total weed and red rice seeds.
	Number.	*Number.*	*Number.*		*Number.*	*Number.*	*Number.*
1	2,480	1,440	3,920	16	1,120	2,480	3,600
2	0	10,800	10,800	17	0	720	720
3	9,360	0	9,360	18	400	9,680	10,080
4	3,920	0	3,920	19	10,080	6,800	16,880
5	1,040	1,040	2,080	20	0	400	400
6	400	1,440	1,840	21	320	720	1,040
7	0	3,920	3,920	22	0	2,080	2,080
8	0	0	0	23	0	960	960
9	5,040	1,040	6,080	24	2,560	0	2,560
10	0	320	320	25	400	0	400
11	0	1,760	1,760	26	720	1,760	2,480
12	0	0	0	27	1,760	10,080	11,840
13	0	1,440	1,440	28	0	0	0
14	320	2,160	2,480	29	1,120	5,760	6,880
15	0	0	0				

GOOD CULTURAL METHODS ESSENTIAL.

Improved cultural methods result in more rice of a higher grade. Good cultural methods require that the fields and levees be kept free

of weeds and red rice at all times. It is not enough that the surface of the land be cleared of these pests just prior to planting, for many of these noxious weed seeds and red rice remain in the soil and the fields are soon as badly infested as ever. Unceasing efforts are required for thorough eradication. The custom of building high and narrow levees in the fields is rapidly falling into disfavor with progressive farmers. Such levees are undesirable because they are too high and narrow to be planted to rice and they serve as an excellent place for noxious weeds to thrive. (Fig. 3.) Low, broad levees should be used and should be planted to rice like the remainder of the field. Weeds and red rice which grow in the fence corners, around the edge of the fields, and along irrigation canals should be cut several times each year to prevent the seed from maturing.

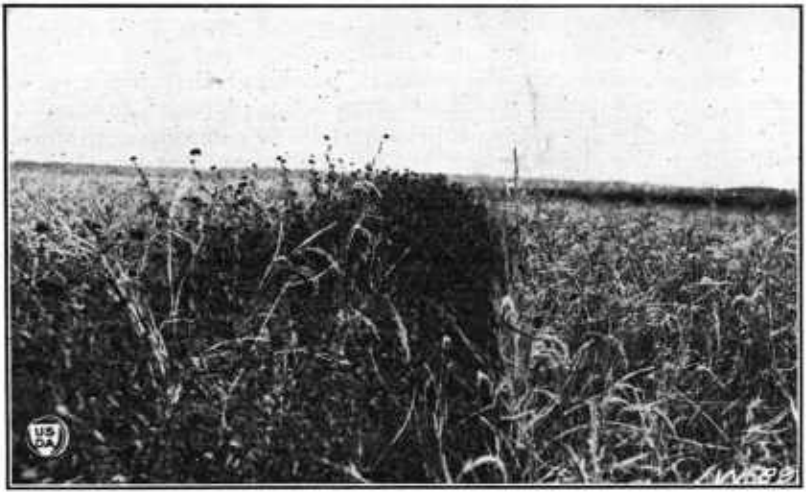

FIG. 3.—A heavy growth of weeds on a levee in a rice field. This condition may be prevented by building low, broad levees and seeding them to rice. Seeds from these weeds will scatter over the field and many will appear in the threshed rice. Value of rice is lowered materially by the presence of weed seeds.

Red rice plants are sometimes found growing in the rice fields even when the seed rice may have been free of red rice. This is especially true where the same land is planted to rice year after year. It is usually because the red rice that grew in a previous crop of rice scattered its seed before or during harvest and came up as volunteer plants. The red rice plants (fig. 4) are easily distinguished after they have headed and, when they are not too numerous in the field, it is profitable to remove them by hand before the seeds mature. Cooperative experiments conducted at the Rice Experiment Station, Crowley, La., show that in badly infested fields red rice may be controlled and eventually eradicated by growing the rice crop in rotation with the Biloxi soy bean.

When a rotation of crops is practiced, care should be taken to prevent the admixture of other grains with rice. In the rice-producing areas of the United States where wheat and barley are raised, mixtures of these grains sometimes occur in the rice fields. It is not likely that barley and wheat seed, if planted with rice, will germinate and grow in those parts of the fields that are covered with

water, but both of these cereals will grow and mature on the levees and on other high spots. Fields that have been seeded to barley or wheat and, because of a poor stand of grain, are later planted with rice, are especially likely to produce a mixed crop along the levees unless care is taken to eradicate thoroughly all plants of the cereal first planted.

It is common practice in some sections where rice is cut by hand to cut the rice only, and to allow the weeds to remain standing in the field, where they mature and scatter their seeds on the ground, and therefore the following crop contains more weeds than the previous one. This is an economic waste that costs rice producers heavily each year. Cutting and burning such weeds immediately after the rice is harvested, to destroy the seeds and prevent them from infesting the following crop, will remedy this condition. Figure 5 shows a rice field heavily infested with weeds.

FIG. 4.—A red rice plant growing in a low spot of a field lying fallow. Note the shape of the panicles. The seed from this plant will shatter and cause the land to be infested with red rice the following season.

MECHANICAL MIXING OF KINDS SHOULD BE AVOIDED.

Care must be taken to see that all sacks for rough rice at threshing time are free of other seeds. New sacks are nearly always clean, but if old sacks are used they should be thoroughly recleaned. Any seed other than rice that may be contained in a sack is readily detected with a " trier " when the rice is sampled, and the presence of even a small percentage of other seeds in a sample of rice tends to lower the value of the lot. It may be that all of the " other cereal grains " found in the sample are only the few kernels that stuck to the inside of the sacks, but unless all sacks are opened and the contents carefully examined there is no way of knowing whether the sample drawn with a trier is truly representative of the

lot or not, so that such rice is likely to sell at a discount. This uncertainty may be eliminated by the use of absolutely clean sacks.

When more than one kind of grain is stored in a warehouse, care should be taken to avoid mixtures. In some sections rice is often stored alongside other grains, and mixtures which are later discovered are the result of careless handling in storage. Sacks of rice sometimes burst in the warehouse and when the rice is swept up and put into new sacks kernels of other grains lying on the floor may be put in the sacks with the rice.

Occasionally sacks of barley or wheat are loaded into a car with a shipment of rice and these grains are at times inadvertently "cut in" with the rice at the mill and the mixture lowers the value of the rice materially. Cars used for the shipment of rough rice, whether in sacks or in bulk, should be thoroughly cleaned before loading to remove all grain left on the floor and around the sides. If bulk rice is loaded into a car in this condition a mixture of rice and these other grains occurs immediately.

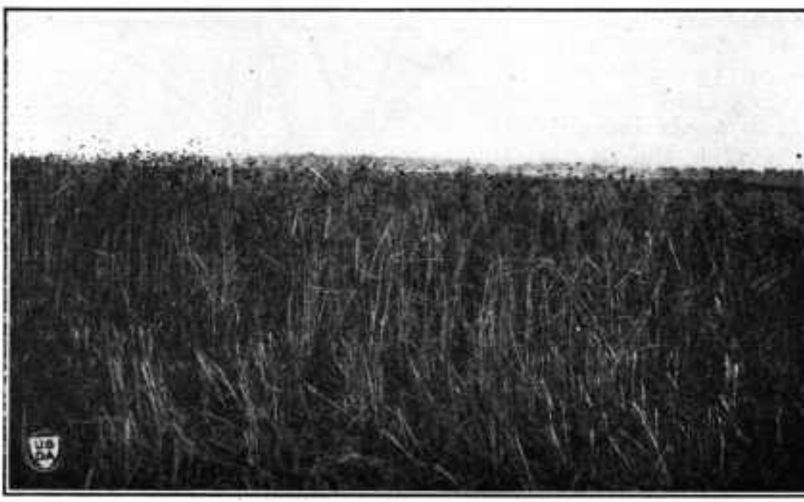

FIG. 5.—A partially cut field of rice badly infested with weeds. The threshed rice from this field will be very seedy and will be of much less value than if it were free of weed seeds.

PREVENTION OF DAMAGED KERNELS, MOISTURE, AND FOREIGN MATERIALS.

The rice crop may be well grown, true to class, and free from weed seeds, red rice, or other cereal seeds, yet suffer serious loss of grade at harvest time and later. The stage of maturity at harvest has considerable influence on the quality of the threshed rice. When harvesting is done before the crop reaches the proper stage of maturity there are many shriveled, chalky, lightweight kernels, and when harvesting is delayed until the crop is overripe the kernels become brittle. The result in either of these cases is that many more of the kernels are broken during the threshing and milling operations than if rice is harvested at the right time, when the

kernels are sound, plump, and well matured. The best time to harvest is usually when the kernels in the upper portion of the majority of the heads are just approaching the hard stage. Cutting should then proceed rapidly, otherwise the last rice cut may be overripe.

The method of cutting and shocking affects the moisture content, field curing, efficiency of threshing, and presence of mud lumps. Two methods of harvesting rice are common in the United States—harvesting by hand and harvesting with a grain binder. (Fig. 6.) Both methods are conducive to the production of high-grade rice, provided the crop is in the right condition when harvesting is done and proper care is used in the performance of the work.

When harvesting is done by hand, the rice is cut with a "reap" hook and is then spread in swaths on the stubble and later bound into sheaves by hand. By this method, harvesting may be done without

FIG. 6.—A binder at work in a rice field. Rice cut by this method should be put into comparative small shocks. The straw and kernels must lose a large percentage of moisture before the grain will be cured and the loss of moisture can not occur quickly unless the air is allowed to circulate through the shock.

bad effects while the rice is still wet with dew, provided it is allowed to lie on the stubble until it is dry, before it is bound into sheaves.

When harvesting is done with a binder, the grain should be free of dew before it is cut. Rice straw at harvest time normally contains a high percentage of moisture, and any additional moisture that may come from the dew and which can not escape readily when the grain is bound into bundles retards and sometimes prevents the natural curing of the grain in the shock. Green weeds contain excessive moisture, and if present in any considerable number prevent, to some extent, the natural drying in the shock. If damp rice bundles are shocked, the rice grains sometimes become moldy and heat damaged.

Whether harvesting may be done more economically by hand or with binders depends chiefly upon the labor situation, weather conditions, and the nature of the soil. When the ground is too soft

from recent irrigation or rains for the binder to operate properly, and plenty of cheap labor is available, hand harvesting is probably preferable. The use of binders, however, saves time and labor and

FIG. 7.—This shock was poorly made and has twisted and fallen down. Practically all of the kernels are exposed. In rainy weather rice in shocks of this kind becomes wet and stained and is often badly smeared with mud.

FIG. 8.—Hand-cut rice curing on the stubble. Care should be taken to see that rice is all up on the stubble, as it may absorb moisture if allowed to remain in contact with damp or wet ground.

reduces the chances of damage to the crop by storms or by becoming overripe before harvesting is finished, because much less time is usually required.

Carelessness and improper shocking is unquestionably the cause of much damaged rice. (Fig. 7.) When the crop is harvested with binders it is advisable to shock the bundles immediately, for they do not dry out readily on the ground, as they absorb moisture from the soil. When harvesting is done by hand, the grain that is cut in the morning should be left on the stubble at least until the dew dries. (Fig. 8.) After it is bound into bundles immediate shocking is recommended.

Shocks always should be located on the highest ground possible, because the high points are the first to dry after irrigations and they are the least likely to collect standing water from heavy rains. In many instances it is practical to dump the bundles from the binder near the levees, and where there are low, broad levees a large number of the shocks may be set upon this high ground. If rice is shocked in low places, water from heavy rains may get up into the bundles and cause the heads to become damaged or it may saturate the straw so much that threshing is very difficult. Rice bundles standing on wet ground also pick up mud, and threshed rice containing mud lumps sells at a discount.

FIG. 9.—A well-made shock of hand-cut rice. The shock is made very compact. Well-cured rice may be shocked in this way without great danger, but damp rice requires more aeration and should be put into smaller shocks.

Shocks that are well built and capped shed water, and the heads of such shocks are protected from the direct rays of the sun. Rice left exposed to the direct rays of the sun for a long time usually becomes brittle. This is detrimental to its milling qualities and causes it to sell for a lower price.

Different methods of shocking are employed for rice harvested by hand than for that harvested with binders. Rice cut by hand and allowed to lie on the stubble until most of the excess moisture has escaped from the straw and grain before binding can be put into slightly larger shocks than rice cut with binders (fig. 9), but such shocks should not be made larger than necessary, for good aeration at all times is beneficial to the grain.

When the rice is harvested with binders it is dangerous to put the bundles into large compact shocks, for it contains practically the

same moisture content as when it was cut and a large percentage of this moisture must escape before the grain will be in a suitable condition for threshing and milling. Small-sized shocks facilitate this process. Rice improperly or insufficiently cured before threshing is usually soft and breaks very easily, which makes it of poor milling quality.

The following method of building shocks for machine-harvested rice usually gives satisfaction: Two bundles are set firmly on the ground with the butts about 1 foot apart and the heads pressed firmly together. Two more bundles are then set in the same manner in a position at right angles to the first pair, bringing the heads of all four bundles together. One bundle is then placed in each of the four spaces between the first two pairs of bundles, which makes, in all, eight bundles standing on the ground. Four bundles are used in capping the shock. The butts of all cap sheaves are spread and

FIG. 10.—A well-made shock of binder-cut rice. The bundles are set up firmly and in such a manner as to allow a circulation of air through the shock. The cap bundles are so placed that very little of the grain is exposed. The heads of the top sheaf hang over the north side of the shock.

the first one is so placed that the heads lie on the top of the shock and the butt end hangs well over the east side of the shock. The next bundle is placed so that the butt end hangs over the north side of the shock, the next bundle so that the butt end hangs over the west side of the shock, and the last bundle is so placed that it covers the heads of the other cap sheaves and its butt end hangs over the south side of the shock. (Fig. 10.) The entire shock should be solidly built and the caps firmly placed so that they will not be blown off by the wind. This form of shock, if properly made, sheds water during rainy weather, protects the grain from the direct rays of the sun, and permits thorough aeration.

The length of time that rice may be safely allowed to stay in the shock before threshing depends largely upon circumstances, but in most cases it is profitable to allow this curing to proceed for at least 10 days or two weeks. If the rice is properly shocked it cures well, threshing is made easy, and the grain when threshed is in good condi-

tion for storing and brings a good price when sold on the market. On the other hand, if threshing is done too soon the straw is tough, the seed does not thresh off the straw easily and is likely to be soft and not in suitable condition for storage or milling. Prematurely threshed rice contains an excess of moisture and therefore is subject to spoilage in storage.

If wet bundles are hauled they should not be threshed as soon as brought in, for if they are put into the separator immediately some of the rice is usually lost because the straw is tough and does not thresh well, and much of the wet straw breaks up and goes into the threshed grain. These small pieces of wet straw almost invariably cause some damage to threshed rice in storage. Kernels in a damp or wet spot in stored threshed rice are likely to begin to germinate and cause the rice to become musty or to heat. If the percentage of moisture in such wet spots is comparatively low the damage is usually confined to a small number of "pockets," but if there are a great many such spots and each spot has a relatively high moisture content entire lots of rice are likely to spoil. Such out-of-condition rice receives the lowest grade and price when sold on the market.

FIG. 11.—Damp and wet bundles of rice being dried on a tarpaulin at the separator before threshing. It is difficult to thresh rice when the straw is wet, and damp rice when put into sacks or into a bin in bulk is liable to spoil in storage.

If bundles are wet but not muddy, it is a good plan to spread them out on a tarpaulin at the threshing separator until dry. (Fig. 11.) They may then be threshed without fear of lowering the market value or endangering the keeping qualities of the threshed rice. But if any of the bundles have mud, in either a wet or dry state, clinging to the butts, all of the muddy part of the straw should be cut off before the bundles are threshed. In case some of the bundles have mud on both the heads and butts it is best to thresh them separately and store the grain separately. By doing this a price-lowering factor is eliminated from the bulk of the crop and the greater part of the grain is made safer for storage purposes. All work of conditioning bundles before threshing should be done on high ground and preferably at the separator.

THRESHING THE GRAIN.

A great deal of rice is lost every season and the quality of much of that saved is materially lowered by improper and careless

handling of the threshing separator. The separator should be put in good repair before the threshing season begins and should be kept in good running order throughout the season. Efficient threshing can not be performed with a machine that is not working properly. An even feed of rice into the machine should be maintained whenever the separator is running. If too heavy feeding is done it is not possible to clean the rice thoroughly and some of the rice is likely to be carried over with the straw into the straw stack. If the feed is too light it often results in the presence of a great many cracked kernels in the threshed grain and a reduced market value of the rice. Feeding a separator spasmodically, heavy at times and light at other times, brings a combination of undesirable results.

As it is essential that as much as possible of the foreign material in rice be removed in threshing, it is advisable to inspect the rice from time to time to see how it is running, with reference to cleaning and breakage of kernels, and to catch some of the straw from the stacker at intervals to determine if any rice is being lost in the straw pile.

FIG. 12.—Sacks of rice left in the field with practically no protection from the weather. When it is necessary to leave rice in the field temporarily it should be stacked up off the ground and covered with tarpaulins or some other waterproof material.

CLEANING ROUGH RICE.

Rough rice should be thoroughly cleaned for either storing or marketing. Running rough rice through a cleaning machine has several advantages in addition to the benefits derived from the removal of the foreign material. When the rice contains a high percentage of moisture, the aerating it receives in cleaning usually reduces the moisture content and lessens the chances that the rice will heat or become musty. If the kernels have begun to heat or have become musty the cleaning machine can be used to advantage in putting the rice into good condition. Recleaning is also a helpful means of retarding the destruction of the kernels by weevils, as many of the weevils are blown out of the rice by the air blast

and others pass through the sieves. If weevil-cut kernels are present, most of the worst ones are removed in the cleaning operation.

Seed rice should always be thoroughly recleaned before planting. A better stand of rice is obtained if the seed rice is free of weed seeds and, what is still more important, the resulting crop will have fewer foreign seeds when it is threshed.

The principal features of an efficient rice-cleaning machine are large-mesh screens for removing the large forms of foreign material, a fan for blowing out the light-weight seeds, straw, dust, and other light matter, and small-mesh sieves for the removal of the broken grains and small weed seeds.

FARM STORAGE.

It is poor economy to take good care of the crop to the stage where the threshed rice is ready for storage and then to allow its quality to become lowered by neglecting to provide suitable storage. The handling of the rice at this time may be the factor that determines whether there will be a profit or loss on the crop.

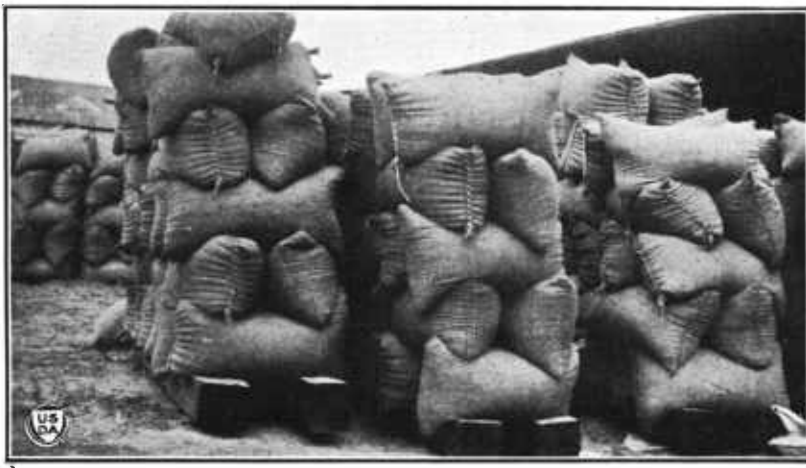

FIG. 13.—Damp rice stacked in the open during favorable weather to prevent spoilage. This method of stacking permits a good circulation of air, which is very beneficial to damp rice. Poles may be used instead of timbers. During damp or rainy weather the sacks should be covered with a good rainproof tarpaulin.

There are two methods of storing rough rice—bag storage and bulk storage—and apparently either method gives satisfaction under normal conditions if care is used. Most of the crop is handled in bags. Regardless of the way in which the rice is to be handled, it is essential for best results that good storage space be provided and ready for use before the crop is threshed.

Bags of rice are often piled in the open near the threshing separator and left there, insufficiently protected from unfavorable weather, for an indefinite length of time. (Fig. 12.) This is a costly practice. When, for some unavoidable reason, it is absolutely necessary to store the sacks in the open, the risk will be much less if poles are first laid parallel to each other on the ground and then another lot of rails laid crosswise on top of these, so that the bottom bags will be raised several inches from the ground. (Fig. 13.) The

finished pile of bags should be protected from the sun and weather with a covering that will shed water.

It is always much safer to store the sacks of rice in a shed or warehouse that has a good roof, a dry floor, and is well ventilated. (Fig. 14.) Ventilation of the walls of the storehouses should be so arranged that rain can not be blown in during stormy weather. The manner in which sacks of rough rice should be piled to prevent spoilage in storage is governed by the condition of the grain. It is not likely that well-cured rice, free from foreign material, will go out of condition if it is stored compactly, but great care must be used with rice which contains either a high moisture content or damp foreign material. Such rice is much more likely to become musty or hot and should be stored in a way that will permit thorough aeration.

It is a good plan to stack sacks of damp rice on poles or boards to keep the bottom bags off the floor and to leave open spaces between the tiers of sacks for air circulation. If rice is exceedingly damp,

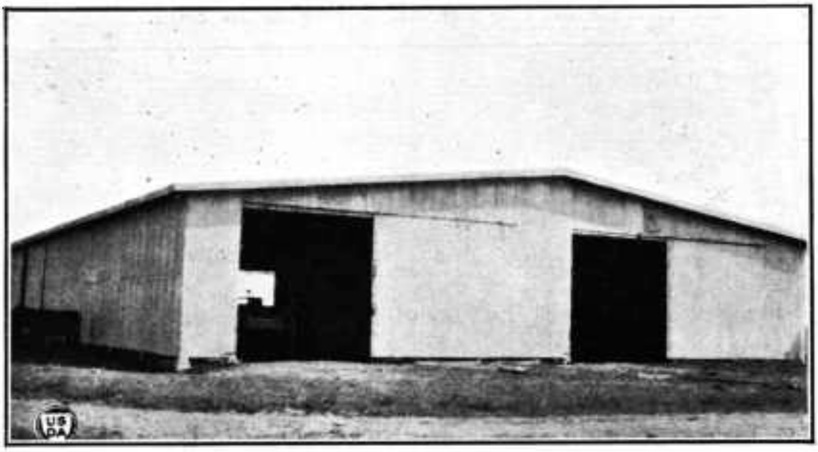

FIG. 14.—This shed was erected on a farm to provide storage space for sacked rice at threshing time and for the protection of the farm implements when no rice is on hand. Sacked rice should always be stored in a dry, well-ventilated place.

the sacks either should be stood on end separately or the rice can be taken out of the sacks and spread in a thin layer on a dry floor and turned occasionally by hand shoveling. Proper care of damp or wet rice sometimes turns what would otherwise be a loss into a profit. Good ventilation of rice in storage prevents losses from spoilage and aids the escape of excess moisture from the rice, thus hardening the kernels to some extent and increasing its milling value.

BULK STORAGE.

Granaries, bins, and elevators used for bulk storage should be built so that the rice will be protected from the weather and still be well ventilated. Ventilators that permit circulation of air through the grain are of simple construction and lower the risk of grain heating. Such ventilators may consist merely of openings cut in the bottoms of the bins and covered with strong fine-mesh wire to prevent the leakage of rice. For this type of ventilator, it is

advisable first to cover the openings with strong wire of any size mesh to support the weight of the grain and then to cover this wire with a fine-mesh screen which will not permit the kernels to pass

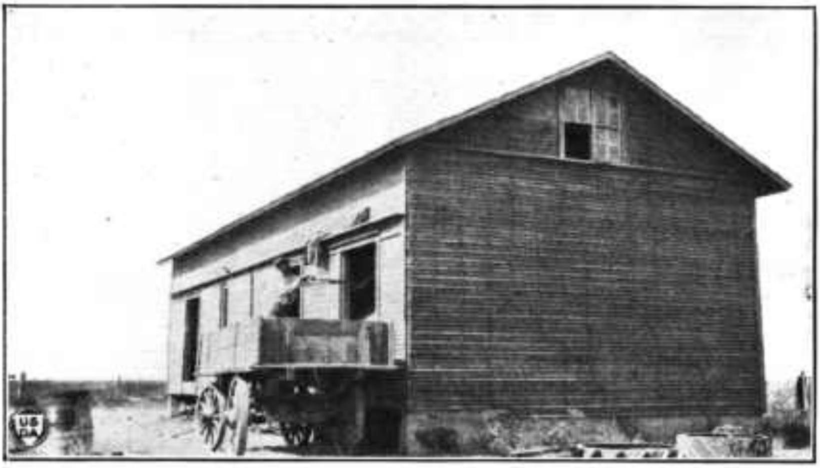

FIG. 15.—A wooden granary used for bulk storage of rice on the farm. Each of the four doors opens into a separate bin, which provides for the storage of four different kinds or grades of rice. The bin partitions are only as high as the eaves and in each end of the granary there are windows in the gable which allow ventilation.

through. The number and size of the openings in the floors depend to some extent upon the size of the bins and the construction of the floors. It is advisable to have as many openings as possible and to have them as large as possible without weakening the floor. It is

FIG. 16.—One type of steel granary for the storage of bulk rough rice. Rice to be stored in this manner should be well cured before storing.

best, as a rule, not to have any opening closer than 3 feet to the edge of the building if the space under the bin is not inclosed, as dampness may enter with the air during wet weather. Then the results are harmful instead of beneficial. Whenever possible the space

under the bin should be inclosed in such a way as to prevent the entrance of outside air in rainy weather.

To insure circulation of air through the rice, openings should be provided at the tops of the bins. In buildings that have gable roofs, and in which the bin partitions are not higher than the eaves, it is best to make the top openings in the ends of the building.

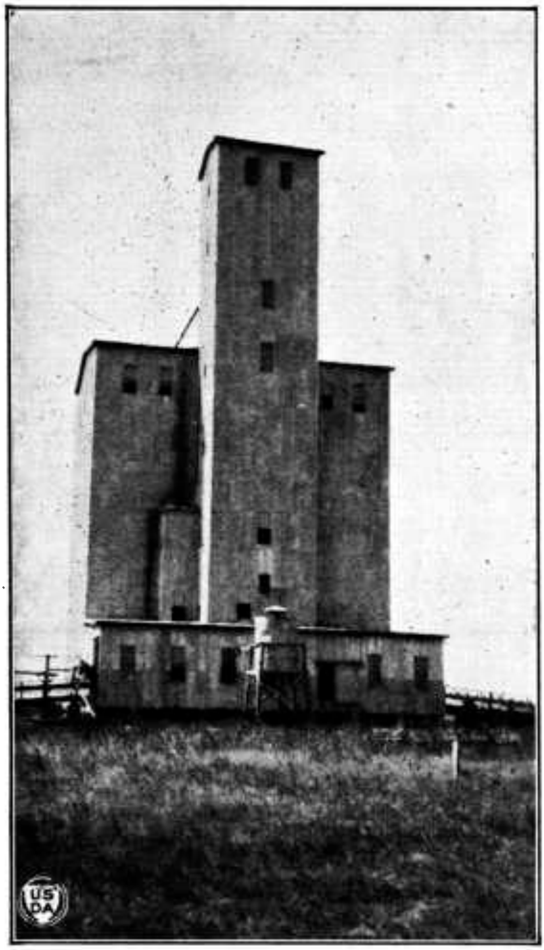

FIG. 17.—An elevator located at a country point used for storage of rice in bulk. This plant is equipped to receive bulk rice from farmers' wagons, to clean foreign material from the rice, to store the rice in large bins, and to load the rice in bulk into railroad cars for shipment to the mills or terminal markets.

These openings may be made weatherproof and still allow the air to pass by placing louver boards in them. These boards have sufficient overlapping to prevent the entrance of rain. The space between boards should not exceed 3 inches. In buildings where it is not possible to construct such top openings a cupola on top of the roof will serve practically the same purpose if provided with louvers.

In bins constructed on these lines, when not more than 8 to 12 feet in depth, there is a natural circulation of air which is usually sufficient to keep rice in good conditon, but if means for forcing a draft through the grain can be devised economically it is highly desirable. This has been done by inclosing the space under the bin except for one opening and placing a fan of some kind in this opening. Forced aeration is especially beneficial to damp rice.

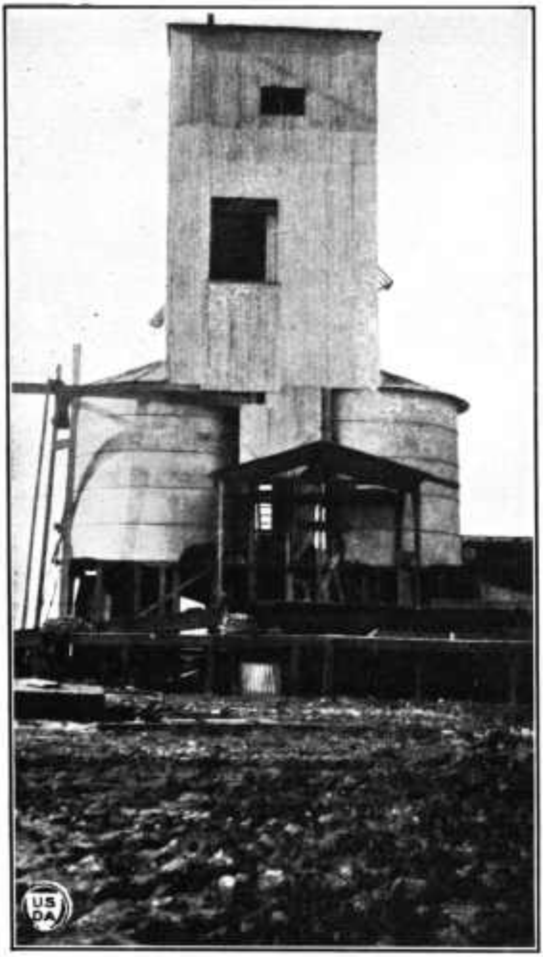

FIG. 18.—A farm elevator erected at a country siding for the purpose of recleaning rice and of providing temporary storage and as a means of loading bulk rice into cars.

Damp bulk rice should be stirred occasionally to prevent heating. This may be done readily in elevators where there is machinery for transferring the grain from one bin to another, but in farm storage it is usually more difficult. However, the elevating machinery with which the grain is put into the tanks or granaries can sometimes be utilized to advantage in transferring the rice. (Fig. 19.) It is well

to put a blast of cool air on the rice at the time of transfer to cool it if it has begun to heat. Aeration can often be accomplished by dropping or "running" the rice through the driveway of a granary, or by transferring it from bin to bin or from tank to tank in the open air. Rice that is cool and in good condition should never be run in humid air or in air that is warmer than the rice, for in the first case the rice is likely to take on moisture from the humid air and in the second case the temperature of the rice is raised.

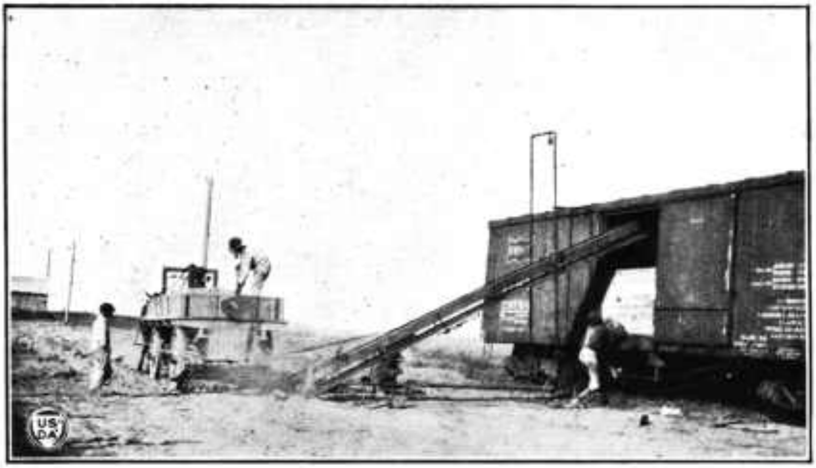

FIG. 19.—Loading bulk rice into a car for shipment at a country siding where there is no elevator. The loading apparatus is driven by a small gasoline engine and can also be used for putting rice into granaries or for transferring rice from one storage bin to another.

MOISTURE CONTENT FOR SAFE STORAGE.

Moisture content of rough rice is a prime factor in determining its keeping qualities in storage. The temperature and humidity of the air also play an important part. A moisture content that may be safe for storage under some conditions may not be safe under other conditions. Therefore, the maximum moisture content for safe storage varies with conditions. It is the consensus of opinion that a moisture content of 14.5 per cent is the maximum limit for safe storage under ordinary conditions in the southern territory. This percentage may be too high for safe-keeping in storage for long periods under unfavorable conditions. On the other hand, rough rice with a moisture content exceeding 14.5 per cent may sometimes be stored with safety if the conditions are very favorable.

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